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Forecasting Covid-19 Mortality in Cameroon

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***Abstract* - In this study, the ANN approach was applied to analyze COVID-19 deaths in Cameroon. The employed data covers the period 1January 2020-20 April 2020 and the out-of-sample period ranges over the period 21 April -31 August 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is quite stable. The results of the study indicate that daily COVID-19 deaths in Cameroon are likely to be less than 5 deaths per day (close to zero) over the out-of-sample period. Therefore there is need for the government of Cameroon to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and scaling up COVID-19 vaccination.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic is a huge global health problem that has invaded the world. The city of China, Wuhan is the origin of the novel coronavirus SARS-COV2 which causes COVID-19 disease (Wang et al, 2020; CDC, 2020; Tang et al, 2020). By the 31st of December 2020 the world had reported 81 484 663 positive COVID-19 cases and 1 798 160 fatalities (WHO, 2020). The pandemic affected different parts of the world with varying magnitude, developed countries recording the highest fatalities (Fodjo et al, 2021). It has been noted that under reporting, early lockdowns, young age of population, previous exposure to other coronaviruses, geographical and genetic factors played a role in reducing the health impacts of the COVID-19 in Africa (Damme et al, 2020; Ticheutchoua et al, 2020). The first case of COVID-19 in Cameroon was reported on the 6th of March 2020 (Fodjo et al, 2020). The government responded to the initial COVID-19 outbreak by closure of schools, temporary ban on public gatherings, restricted movement of people, hygiene practices, social distancing and wearing of face masks (Cameroon, 2020).

There are not so many empirical COVID-19 studies that have been done in Cameroon. In this paper we shall mention some of them. Fodjo et al (2021) conducted a six-month online survey to assess the preventive behavior of Cameroonian adults during the COVID-19 outbreak. A five-point adherence score was constructed based on self-reported observance of the following preventive measures: physical distancing, face mask use, hand hygiene, not touching one's face, and covering the mouth when coughing or sneezing. Predictors of adherence were investigated using ordinal logistic regression models. Predictors for higher adherence included higher age, receiving COVID-19 information from health personnel, and agreeing with the necessity of lockdown measures. Nguemdjo et al (2020) analyzed the evolution of COVID-19 in Cameroon over the period March 6–April 2020 using SIR models. Data used in their study was obtained from the Cameroonian Public Health Ministry. The results suggested that over the identified period, the reproduction number of COVID-19 in Cameroon was about 1.5, and the peak of the infection should have occurred at the end of May 2020 with about 7.7% of the population infected. The artificial neural network technique was applied by Nyoni et al (2020) to predict daily COVID-19 infections in Cameroon. The employed data covered the period March 6, 2020 to October 31, 2020 and the out-of-sample period ranged over the period November 2020 to April 2021. The results of the study indicated that the country was likely to record about 26 new cases per day over the period November 2020 to April 2021.In this study we aim to predict daily COVID-19 deaths in Cameroon using an artificial intelligence technique. The findings of the study will trigger an evidence based approach in the COVID-19 response.

II. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent

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activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting COVID-19 deaths in Cameroon.

Data Issues

This study is based on daily COVID-19 deaths in Cameroon for the period 1 January 2020 – 20 April 2021. The out-of-sample forecast covers the period 21 April – 31 August 2021. All the data employed in this research paper was gathered from the Johns Hopkins University (USA).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	C
Observations	464 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	2.702696
MSE	67.956393
MAE	4.694054

Residual Analysis for the Applied Model

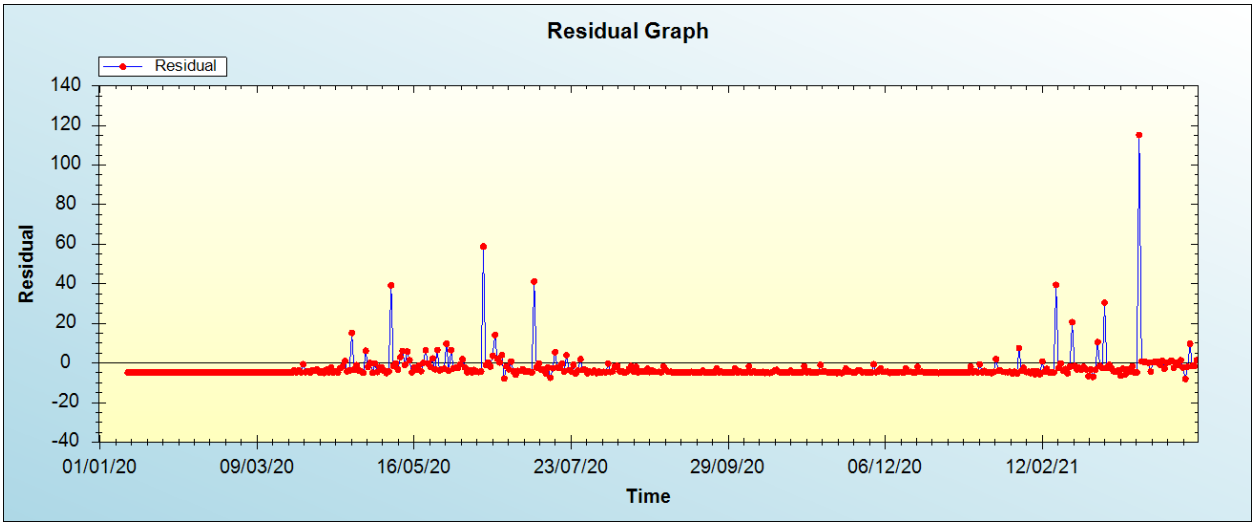

Figure 1: Residual analysis

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In-sample Forecast for C

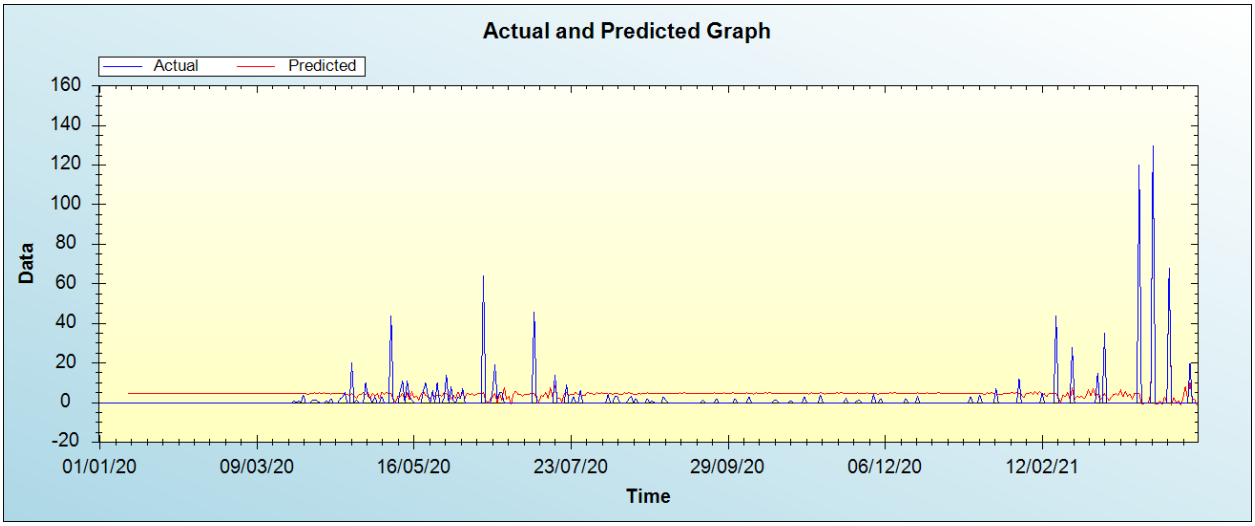

Figure 2: In-sample forecast for the C series

Out-of-Sample Forecast for C: Actual and Forecasted Graph

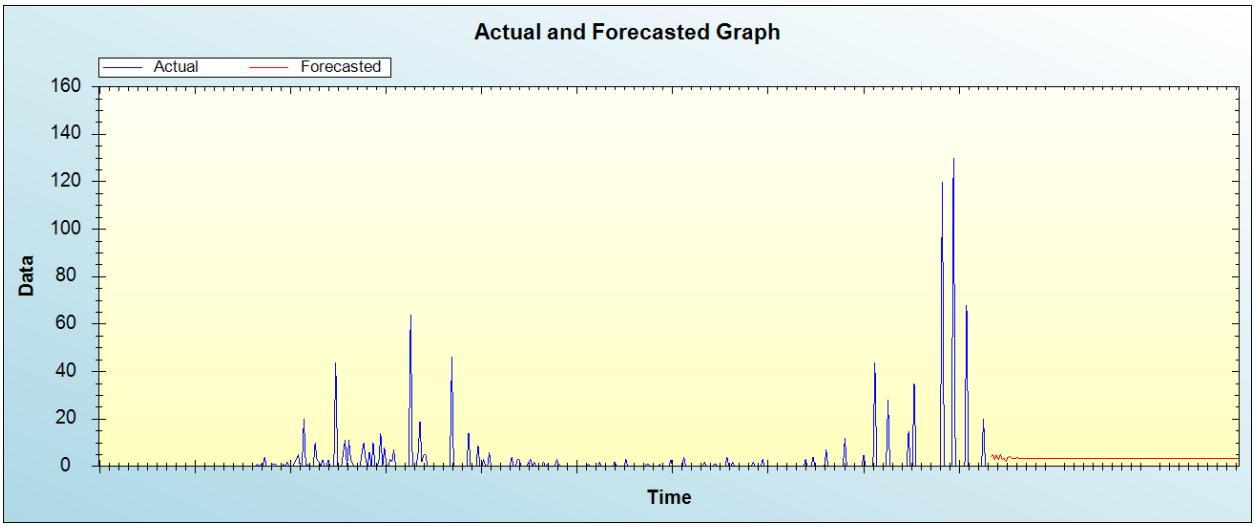

Figure 3: Out-of-sample forecast for C: actual and forecasted graph

Out-of-Sample Forecast for C: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Projected COVID-19 deaths
21/04/21	4.1555
22/04/21	4.9276
23/04/21	2.8343
24/04/21	4.9140
25/04/21	2.9129
26/04/21	5.1178
27/04/21	2.9803
28/04/21	3.4514
29/04/21	2.1945
30/04/21	3.9123
01/05/21	4.3433
02/05/21	3.4578
03/05/21	3.6054
04/05/21	3.1425

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05/05/21	3.7707
06/05/21	3.2863
07/05/21	3.5906
08/05/21	3.3660
09/05/21	3.5779
10/05/21	3.6303
11/05/21	3.5362
12/05/21	3.5096
13/05/21	3.3776
14/05/21	3.5801
15/05/21	3.4940
16/05/21	3.5611
17/05/21	3.4893
18/05/21	3.5309
19/05/21	3.5263
20/05/21	3.5115
21/05/21	3.5200
22/05/21	3.4902
23/05/21	3.5298
24/05/21	3.5137
25/05/21	3.5317
26/05/21	3.5076
27/05/21	3.5159
28/05/21	3.5158
29/05/21	3.5154
30/05/21	3.5182
31/05/21	3.5119
01/06/21	3.5199
02/06/21	3.5148
03/06/21	3.5195
04/06/21	3.5141
05/06/21	3.5160
06/06/21	3.5158
07/06/21	3.5165
08/06/21	3.5172
09/06/21	3.5154
10/06/21	3.5170
11/06/21	3.5157
12/06/21	3.5169
13/06/21	3.5158
14/06/21	3.5163
15/06/21	3.5162
16/06/21	3.5164
17/06/21	3.5165
18/06/21	3.5161
19/06/21	3.5164
20/06/21	3.5161
21/06/21	3.5164
22/06/21	3.5162
23/06/21	3.5163
24/06/21	3.5162
25/06/21	3.5163
26/06/21	3.5163
27/06/21	3.5162
28/06/21	3.5163
29/06/21	3.5162
30/06/21	3.5163
01/07/21	3.5163
02/07/21	3.5163
03/07/21	3.5163
04/07/21	3.5163
05/07/21	3.5163
06/07/21	3.5163
07/07/21	3.5163

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08/07/21	3.5163
09/07/21	3.5163
10/07/21	3.5163
11/07/21	3.5163
12/07/21	3.5163
13/07/21	3.5163
14/07/21	3.5163
15/07/21	3.5163
16/07/21	3.5163
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28/07/21	3.5163
29/07/21	3.5163
30/07/21	3.5163
31/07/21	3.5163
01/08/21	3.5163
02/08/21	3.5163
03/08/21	3.5163
04/08/21	3.5163
05/08/21	3.5163
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26/08/21	3.5163
27/08/21	3.5163
28/08/21	3.5163
29/08/21	3.5163
30/08/21	3.5163
31/08/21	3.5163

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that daily COVID-19 deaths in Cameroon are likely to be less than 5 deaths per day (close to zero) over the out-of-sample period.

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IV. CONCLUSION AND POLICY RECOMMENDATIONS

Although the health impact of COVID-19 appears to be less in Africa as compared to other continents like Europe, it is very important to continue adhering to the WHO guidelines on prevention and control of the SARS-COV2 virus. Health education is a key component of the prevention strategy so that communities can strictly adhere to mitigation measures such as social distancing, wearing masks, quarantine, isolation and hygiene practices. In this study we applied the artificial neural network approach to predict COVID-19 deaths in Cameroon. The results of the study revealed that daily COVID-19 deaths in Cameroon are likely to be less than 5 deaths per day (close to zero) over the out-of-sample period. Hence the authorities in Cameroon should scale up COVID-19 vaccination in order to achieve herd immunity.

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